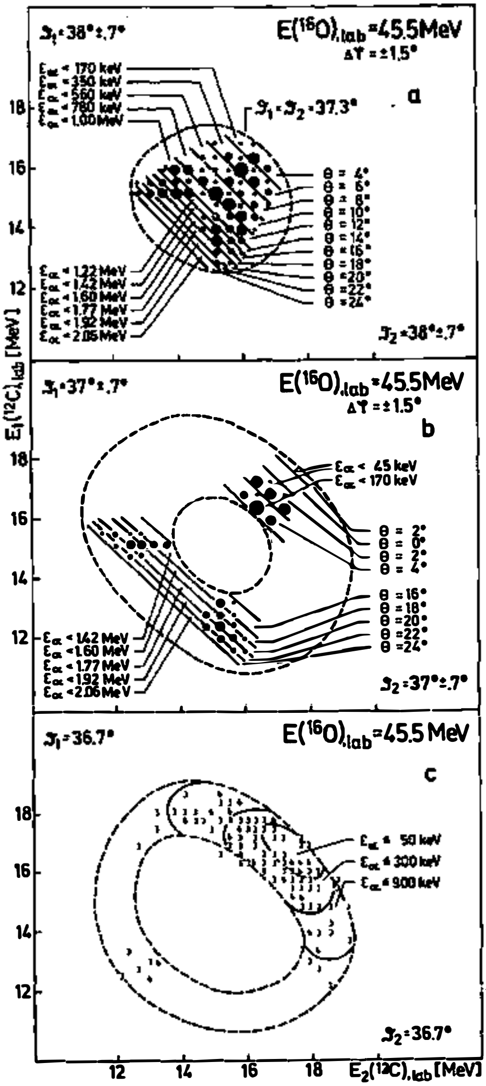
ON THE THREE-BODY DECAY OF THE 14^+ RESONANCE IN $^{16}O + {}^{12}C$

H.U. Gersch, H. Schobbert, H.J. Wiebicke
Zentralinstitut für Kernforschung Rossendorf, 8051 Dresden, DDR

Scheurer et al. [1] found evidence for the three-body ^{12}C-α-^{12}C configuration in the E_{cm} = 19.7 MeV 14^+ resonance in the $^{16}O + {}^{12}C$ reaction. Wiebicke and Shukov [2] have calculated resonance energies and internal wave functions for possible ^{12}C-α-^{12}C configurations. Especially the energy of the lowest 14^+ state has been found closely to the resonance energy.
We assume, that the structure of the resonance consists mainly of different two-body configurations with a remarkable three-body admixture. We apply a simple model for the three-body decay of the 14^+ resonance and compare the results with the measurements of Scheurer et al.
Our calculations have been performed in four steps:
1.) Calculation of the probability density inside the potential barrier. The deviation from the streched chain θ is an important parameter. The probability density vanishes at $\theta \rightarrow 0^o$, reaches its maximum at $\theta = 10^o$ and becomes small for $\theta > 30^o$.
2.) Penetration of the barrier for such events, for which the system decays immediately into three particles with approximately the same kinetic energies for the two carbon nuclei.
3.) Calculation of the classical trajectories outside the barrier.
4.) Transformation into the laboratory system.
Now we simulated an exclusive coincidence experiment with detectors for the two ^{12}C nuclei at positions given by the angles ϑ_1 and ϑ_2 in the reaction plane. In fig. 1a and b are plotted the expected events with the energies E_1 and E_2 of the ^{12}C nuclei for symmetric detector positions near the kinematioal limit ($\vartheta_1 = \vartheta_2 = 38^o$) and for smaller angles, resp. The sices of the black points are a measure for the cross section. Comparing figures 1a and b the sensitive dependence of the kinematic loci on the detector position becomes evident. Different θ values of the internal wave function are kinema-



tically allowed at different angles. Especially in the second setup (1b) events corresponding to the maximum of the wave function at $\theta = 10^o$ can not be detected.

Fig. 1c shows the coincidence plot received by Scheurer et al. with detector positions comparable to those in fig. 1b. Indeed, for the c.m. alpha energy $\mathcal{E}_\alpha$ = 0 MeV ($\theta = 0^o$) very few events have been found, while a clearly indicated increase can be seen at decreasing energies $E_1=E_2$. This tendency is in qualitative agreement with our model.

We conclude, that coincidence experiments at different detector angles in connexion with the presented model can give more detailed information on the structure of three-body components in nuclear molecules.

Fig. 1. Coincidence plots of a "theoretical experiment" based on our model (a and b) and of the real experiment (c) [1].

References

1) J. N. Scheurer, D. Bertault, M. Caussanel, J. L. Quebert, and J. P. Fouan, Nucl. Phys. A 319 (1979) 274.

2) H. J. Wiebicke and M. Shukov, Nucl. Phys. A (1981).